WHAT IS CLAIMED IS:

1. A medical system comprising:

a carrier;

a multiplicity of electromechanical transducers mounted to said carrier, said transducers being disposable in effective pressure-wave-transmitting contact with a patient;

energization means operatively connected to a first plurality of said transducers forsupplying same with electrical signals of at least one pre-established ultrasonic frequency to produce first pressure waves in the patient; and

a control unit operatively connected to said energization means, said control unit including an electronic analyzer operatively connected to a second plurality of said transducers for performing electronic 3D volumetric data acquisition and imaging of internal tissue structures of the patient by analyzing signals generated by said second plurality of said transducers in response to second pressure waves produced at said internal tissue structures in response to said first pressure waves, said control unit including phased-array signal processing circuitry for effectuating an electronic scanning of the internal tissue structures to facilitate electronic 3D volumetric data acquisition.

2. The system defined in claim 1 wherein said carrier is rigid.

3. The system defined in claim 2 wherein said carrier comprises a plurality of rigid

modular substrates rigidly connected to one another, each of said substrates holding a plurality of said transducers.

4. The system defined in claim 2 wherein said carrier is provided with a fluid-filled flexible bag disposable in contact with the patient for facilitating transmission of said first pressure waves into the patient from said first plurality of said transducers and reception of said second pressure waves by said second plurality of said transducers.

5. The system defined in claim 1 wherein said phased-array signal processing circuitry include means operatively connected to said energization means for independently varying a time delay of said electrical signals across said first plurality of transducers to effectuate an electronic scanning of said internal tissue structures of the patient by said first pressure waves.

6. The system defined in claim 5 wherein said means for varying includes switching circuitry operatively connected to said first plurality of said transducers.

7. The system defined in claim 1 wherein said phased-array signal processing circuitry includes switching circuitry for varying sampling times of said second pressure waves by said second plurality of said transducers and further including combining circuitry for combining the sampled signals to effectuate an electronic scanning of said second pressure waves by said second plurality of transducers.

8. The system defined in claim 7 wherein said means for varying includes switching circuitry.

9. The system defined in claim 1 wherein said second plurality of said transducers includes transducers different from the transducers in said first plurality of said transducers.

10. The system defined in claim 1 wherein said control unit includes circuitry operatively connected to said energization means for varying said frequency to facilitate collection of three-dimensional structural data pertaining to tissue structures at different depths in the patient.

11. The system defined in claim 1 wherein said carrier is provided with at least one chamber for holding a fluid, said transducers being in pressure-wave communication with said chamber, thereby facilitating pressure wave transmission from said first plurality of said transducers to the patient and from the patient to said second plurality of said transducers.

12. The system defined in claim 1, further comprising at least one display operatively connected to said analyzer for providing an image of said internal tissue structures of the patient.

13. A medical method comprising:

providing a carrier holding a multiplicity of electromechanical transducers;

placing said carrier and a patient adjacent to one another so that said transducers are disposed in effective pressure-wave-transmitting contact with the patient;

supplying a first plurality of said transducers with electrical signals of at least one pre-established ultrasonic frequency to produce first pressure waves in the patient;

receiving, via a second plurality of said transducers, second pressure waves produced at internal tissue structures of the patient in response to said first pressure waves; and

performing electronic 3D volumetric data acquisition and imaging of said internal tissue structures by analyzing signals generated by said second plurality of said transducers in response to said second pressure waves,

at least one of the supplying and receiving steps being executed to effectuate an electronic scanning of said internal tissue structures.

14. The method defined in claim 13 wherein the electronic scanning is accomplished by varying a time delay of said electrical signals across said first plurality of said transducers to effectuate a phased-array electronic scanning of internal tissues of the patient by said first pressure waves.

15. The method defined in claim 14 wherein the varying of the time delay of said electrical signals includes operating switching circuitry operatively connected to said first plurality of said transducers.

16. The method defined in claim 13 wherein the electronic scanning is accomplished by varying sampling time or phase of said second plurality of said transducers.

17. The method defined in claim 16 wherein the varying of the sampling time or phase of said electrical signals includes operating switching circuitry operatively connected to said second plurality of said transducers.

18. The method defined in claim 13 wherein said carrier is rigid, further comprising disposing a flexible fluid-filled bag between the patient and said carrier and transmitting said first pressure waves and receiving said second pressure waves through said fluid filled flexible bag

19. The method defined in claim 13, further comprising varying said frequency to facilitate collection of three-dimensional structural data pertaining to tissue structures at different depths in the patient.

20. The method defined in claim 13, further comprising generating an image of the internal tissues of the patient on at least one display.

21. The method defined in claim 13, further comprising maintaining said transducers in substantially fixed positions relative to one another during:

the supplying of said first plurality of said transducers with said electrical signals;

the receiving, via said second plurality of said transducers, of said second pressure waves;

and

the performing of said 3D volumetric data acquisition and imaging of said internal tissue structures.

22. A medical system comprising:

a carrier;

a multiplicity of electromechanical transducers mounted to said carrier;

energization means operatively connected to a first plurality of said transducers for supplying same with electrical signals of at least one pre-established ultrasonic frequency to produce first pressure waves in the patient; and

a control unit operatively connected to said energization means for operating same to produce said first pressure waves in the patient, said control unit including an electronic analyzer operatively connected to a second plurality of said transducers for performing electronic 3D volumetric data acquisition and imaging of internal tissues of the patient by analyzing signals generated by said second plurality of said transducers in response to second pressure waves produced at internal tissues of the patient in response to said first pressure waves, said control unit being operatively connected to said second plurality of said transducers to gather and organize data from said second plurality of said transducers so that said second plurality of transducers define a plurality of data gathering apertures, said control unit including circuitry for coherent aperture combining to coherently combine structural data from the respective apertures.

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23. The system defined in claim 22 wherein said carrier includes a plurality of rigid substrates each disposable in pressure-wave transmitting contact with the patient, each of said substrates carrying a respective plurality of said transducers, each of said substrates carrying at least one of said second plurality of said transducers so that each of said substrates represents a respective one of said data gathering apertures.

24. The system defined in claim 23 wherein said substrates are movably connected to one another, said circuitry including position determination or calibration means for determining relative positions and orientations of said substrates relative to one another.

25. The system defined in claim 24 wherein said position determination or calibration means includes a multiplicity of point scatterers, said position determination or calibration means further including programmed componentry operatively connected to said energization means for periodically scanning said point scatterers with first ultrasonic pressure waves and calculating instantaneous positions of said point scatterers as scanned by each of said substrates using second ultrasonic pressure waves produced at said point scatterers in response to said first ultrasonic pressure waves.

26. The system defined in claim 25 wherein said electronic analyzer includes circuit components for sampling data from said second plurality of said transducers so that at least some of said transducers form a plurality of data gathering apertures, said control unit including

coherent aperture combining circuitry for coherently combining structural data from the respective apertures, said position determination or calibration means including circuitry for executing a self-cohering algorithm (a)computing relative positions and orientations of said substrates using instantaneous position measurements and (b) adjusting signals from coherently combined apertures to enable constructive addition of said signals from said coherently combined apertures.

27. The system defined in claim 25 wherein said position determination or calibration means includes means for executing computations according to a self-cohering algorithm.

28. The system defined in claim 24 wherein said position determination or calibration means includes programmed componentry operatively connected to said energization means for periodically energizing at some of said transducers with at least one predetermined electrical frequency and calculating instantaneous positions of the transducers so energized.

29. The system defined in claim 23, further comprising at least one display operatively connected to said analyzer for providing an image of said internal tissue structures of the patient.

30. The system defined in claim 23 wherein said substrates are connected to one another via a flexible linkage so that said substrates are extendable at a variable angle with respect to one

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another.

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31. A medical method comprising:

providing a carrier holding a multiplicity of electromechanical transducers defining respective data gathering apertures;

placing said carrier and a patient adjacent to one another so that said transducers are disposed in effective pressure-wave-transmitting contact with the patient;

supplying a first plurality of said transducers with electrical signals of at least one pre-established ultrasonic frequency to produce first pressure waves in the patient;

receiving, via a second plurality of said transducers, second pressure waves produced at internal tissue structures of the patient in response to said first pressure waves; and

performing electronic 3D volumetric data acquisition and imaging of said internal tissue structures by analyzing signals generated by said second plurality of said transducers in response to said second pressure waves,

at least one of the steps of supplying and receiving including coherently combining structural data from the respective apertures.

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32. The method defined in claim 31 wherein said carrier includes a plurality of rigid substrates and wherein the step of coherently combining includes determining relative positions and orientations of said substrates relative to one another.

33. The method defined in claim 32 wherein each of said substrates is provided with a plurality of point scatterers, the determining of relative positions and orientations of said substrates including periodically scanning said point scatterers with ultrasonic pressure waves and calculating instantaneous positions of said point scatterers.

34. The method defined in claim 33 wherein the determining of relative positions and orientations of said carriers includes executing computations according to a self-cohering algorithm.

35. The method defined in claim 32 wherein the determining of relative positions and orientations of said carriers includes periodically energizing at some of said transducers with at least one predetermined electrical frequency and calculating instantaneous positions of the transducers so energized.

36. The method defined in claim 35 wherein the determining of relative positions and orientations of said carriers includes executing computations according to a self-cohering algorithm.

37. A medical scanning apparatus comprising:

a plurality of 1.5D transducer arrays rigidly connected to one another; and

phased-array signal processing circuitry operatively connected to said 1.5D transducer

arrays, said phased-array signal processing circuitry for operating said transducer arrays and processing signals therefrom in a coherent aperture combining mode to effectuate an electronic 3D volumetric scan of a patient's internal tissues.

38. The apparatus defined in claim 37 wherein said phased-array signal processing circuitry includes means for effectuating a 2D scan in elevation and azimuth directions of said transducer arrays

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39. A medical method comprising:

disposing a multiplicity of electromechanical transducers in a predetermined array in effective pressure-wave-transmitting contact with a patient;

after the disposing of said transducers in contact with the patient, selectively energizing a first plurality of said transducers to transmit a plurality of ultrasonic pulses into the patient, said pulses inducing a generation of reflected pressure waves at internal tissue structures in the patient, said pulses being transmitted into the patient prior to a return to said transducers of a substantial amount of the reflected pressure waves, said pulses being differentially coded to enable detection of respective series of reflected pressure waves;

receiving, via a second plurality of said transducers, the reflected pressure waves produced at the internal tissue structures of the patient in response to said pulses;

decoding the reflected pressure waves to associate the reflected pressure waves with respective ones of said pulses; and

performing electronic 3D volumetric data acquisition and imaging of said internal tissue structures in part by analyzing the decoded received reflected pressure waves.

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~~40~~. The method defined in claim ~~39~~ wherein the differential coding of said pulses is a spatial coding.

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~~41~~. The method defined in claim ~~40~~ wherein said pulses are transmitted in respective different directions into the patient.

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a ~~42~~. The method defined in claim ~~39~~ wherein said transducers are mounted to a flexible web, the disposing of said transducers in a predetermined array in effective pressure-wave-transmitting contact with a patient including placing said web in contact with the patient.

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